

AMENDMENTS TO THE CLAIMS

1. (Withdrawn) A liquid-crystal display device which comprises a first substrate having thereon plural electrodes that include a scanning signal line, an image signal line, a pixel electrode and others; a second substrate having thereon a color filter, a light-shielding film and others, and spaced from the first substrate via a predetermined distance therebetween; an alignment layer formed on each of the facing surfaces of the two substrates; spacers to define the distance between the two substrates; and a liquid crystal layer disposed between the two substrates, to which is applied a voltage between the electrodes to thereby form an electric field nearly parallel to the surfaces of the substrates so that the liquid crystal molecules therein undergo in-plane response to the electric field;

the device being characterized in that the surface of each spacer is coated with a thermoplastic polymer prepared through graft polymerization of a molecular compound having a vinyl group or a polymerization initiator, with one or more polymerizable monomers at the grafting point of the vinyl group or the polymerization initiator, and each spacer is fixed onto the alignment layer on at least one of the first substrate and the second substrate, via van der Waals bonding or hydrogen bonding between the functional group of the monomers constituting the thermoplastic polymer and the alignment layer.

2. (Withdrawn) The liquid-crystal display device as claimed in claim 1, wherein the thermoplastic polymer has a number of long-chain alkyl groups in its surface.

3. (Withdrawn) A liquid-crystal display device which comprises a first substrate having thereon plural electrodes that include a scanning signal line, an image signal line, a pixel electrode and others; a second substrate having thereon a color filter, a light-shielding film and others, and spaced from the first substrate via a predetermined distance therebetween; an alignment layer formed on each of the facing surfaces of the two substrates; spacers to define the distance between the two substrates; and a liquid crystal layer disposed between the two substrates, to which is applied a voltage between the electrodes to thereby form an electric field nearly parallel to the surfaces of the substrates so that the liquid crystal molecules therein undergo in-plane response to the electric field;

the device being characterized in that the spacers are made of a polymer compound having a number of long-chain alkyl groups in its surface.

4. (Withdrawn) The liquid-crystal display device as claimed in claim 2, wherein, in the polymer compound for the spacers, the long-chain alkyl groups are bonded to the graft polymer chains through graft polymerization.

5. (Withdrawn) The liquid-crystal display device as claimed in claim 2, wherein the long-chain alkyl groups each have at least 6 carbon atoms.

6. (Withdrawn) A liquid-crystal display device which comprises a first substrate having thereon plural electrodes that include a scanning signal line, an image signal line, a pixel electrode and others; a second substrate having thereon a color filter, a light-shielding film and others, and spaced from the first substrate via a predetermined distance therebetween; an

alignment layer formed on each of the facing surfaces of the two substrates; spacers to define the distance between the two substrates; and a liquid crystal layer disposed between the two substrates, to which is applied a voltage between the electrodes to thereby form an electric field nearly parallel to the surfaces of the substrates so that the liquid crystal molecules therein undergo in-plane response to the electric field;

the device being characterized in that a projecting pattern is locally formed below the alignment layer on the first substrate but above one or both of the scanning signal line and the image signal line, and the distance between the first substrate and the second substrate is defined by the spacers disposed on the projecting pattern while the spacers in the other region are so controlled that they are not kept in contact with any one of the first substrate and the second substrate.

7. (Withdrawn) A liquid-crystal display device which comprises a first substrate having thereon plural electrodes that include a scanning signal line, an image signal line, a pixel electrode and others; a second substrate having thereon a color filter, a light-shielding film and others, and spaced from the first substrate via a predetermined distance therebetween; an alignment layer formed on each of the facing surfaces of the two substrates; spacers to define the distance between the two substrates; and a liquid crystal layer disposed between the two substrates, to which is applied a voltage between the electrodes to thereby form an electric field nearly parallel to the surfaces of the substrates so that the liquid crystal molecules therein undergo in-plane response to the electric field;

the device being characterized in that a projecting pattern is locally formed below the alignment layer on the second substrate but above the light-shielding film, and the distance

between the first substrate and the second substrate is defined by the spacers disposed on the projecting pattern while the spacers in the other region are so controlled that they are not kept in contact with any one of the first substrate and the second substrate.

8. (Withdrawn) The liquid-crystal display device as claimed in claim 7, wherein the projecting pattern has a height of at least 0.6 μm .

9. (Withdrawn) A liquid-crystal display device which comprises a first substrate having thereon plural electrodes that include a scanning signal line, an image signal line, a pixel electrode and others; a second substrate having thereon a color filter, a light-shielding film and others, and spaced from the first substrate via a predetermined distance therebetween; an alignment layer formed on each of the facing surfaces of the two substrates; spacers to define the distance between the two substrates; and a liquid crystal layer disposed between the two substrates, to which is applied a voltage between the electrodes to thereby form an electric field nearly parallel to the surfaces of the substrates so that the liquid crystal molecules therein undergo in-plane response to the electric field;

the device being characterized in that projecting patterns are locally formed below the alignment layer on the first substrate but above one or both of the scanning signal line and the image signal line, and below the alignment layer on the second substrate but above the light-shielding film in such a manner that the two patterns face to each other, and the distance between the first substrate and the second substrate is defined by the spacers disposed between the facing projecting patterns while the spacers in the other region are so controlled that they are not kept in contact with any one of the first substrate and the second substrate.

10. (Withdrawn) The liquid-crystal display device as claimed in claim 9, wherein the total height of the projecting patterns formed on the first substrate and the second substrate is at least 0.6 μm .

11. (Withdrawn) The liquid-crystal display device as claimed in claim 6, wherein the projecting pattern is made of pigment or an insulating material such as SiN, SiO₂ or the like.

12. (Withdrawn) A liquid-crystal display device which comprises a first substrate having thereon plural electrodes that include a scanning signal line, an image signal line, a pixel electrode and others; a second substrate having thereon a color filter, a light-shielding film and others, and spaced from the first substrate via a predetermined distance therebetween; an alignment layer formed on each of the facing surfaces of the two substrates; spacers to define the distance between the two substrates; and a liquid crystal layer disposed between the two substrates, to which is applied a voltage between the electrodes to thereby form an electric field nearly parallel to the surfaces of the substrates so that the liquid crystal molecules therein undergo in-plane response to the electric field;

the device being characterized in that the diameter of each spacer is smaller in some degree than the distance between the two substrates so that the spacers are not kept in contact with any one of the first substrate and the second substrate in at least the display area.

13. (Withdrawn) The liquid-crystal display device as claimed in claim 12, wherein the diameter, d, of each spacer satisfies $D - d > 0.2 \mu\text{m}$ in which D indicates the distance between the two substrates.

14. (Withdrawn) A liquid-crystal display device which comprises a first substrate having thereon plural electrodes that include a scanning signal line, an image signal line, a pixel electrode and others; a second substrate having thereon a color filter, a light-shielding film and others, and spaced from the first substrate via a predetermined distance therebetween; an alignment layer formed on each of the facing surfaces of the two substrates; spacers to define the distance between the two substrates; and a liquid crystal layer disposed between the two substrates, to which is applied a voltage between the electrodes to thereby form an electric field nearly parallel to the surfaces of the substrates so that the liquid crystal molecules therein undergo in-plane response to the electric field;

the device being characterized in that the inner pressure in the area where liquid crystal molecules are disposed is lower by at most 0.3 kgf/cm^2 than the atmospheric pressure.

15. (Currently Amended) A process for fabricating a liquid crystal display, comprising the steps of:

forming a panel of an in-plane switching type liquid display by joining a first substrate and a second substrate together with a sealant, said first substrate including a scan signal line, an image signal line, and a plurality of electrodes; and a first orientation controlling membrane,
forming a said second substrate including a color filter, and a shading plate, and a second orientation controlling membrane, said sealant being formed at outer edge between the substrates

~~and a part thereof reaching ends of the substrates to form an injection inlet for injecting liquid crystal;~~

forming a projecting pattern either at a position corresponding to the scan signal line on one face of the first substrate or at a position corresponding to the shading membrane on one face of the second substrate ~~on an under layer of the first orientation controlling membrane, on an under layer of the second orientation controlling membrane, or on both under layers;~~

forming an orientation controlling membrane on a face of the first or second substrate on which said projecting pattern is formed;

disposing orientation controlling membranes on the first and second substrate so as to face each other;

defining a gap between the first substrate and the second substrates by

disposing a spacer, which is smaller than said gap and having a functional group on the surface thereof, on said projecting pattern, and

bringing ~~said all spacers disposed at parts other than said projecting pattern~~ into contact only with either the first orientation controlling membrane of either the first substrate or the second substrate or the second orientation controlling membrane at a portion other than said projecting pattern using van der Waals bonding or hydrogen bonding;

forming a panel of an in-plane switching type liquid display by joining said first substrate and said second substrate together with a sealant that is formed at an outer edge between the first and second substrates and a part thereof reaching ends of the first and second substrates to form an injection inlet for injecting liquid crystal;

disposing said panel in a liquid crystal injector in which a container filled with liquid crystal is disposed;

bringing back a pressure of said liquid crystal injector to atmospheric pressure while said injection opening being soaked into liquid crystal in said container, after evacuating air from said liquid crystal injector and said panel; and

sealing said injecting opening without any external pressure on said panel, after filling said panel with liquid crystal through said injection inlet utilizing pressure difference.

16. (Currently Amended) A process for fabricating a liquid crystal display, comprising the steps of:

~~forming a panel of an in-plane switching type liquid display by joining a first substrate and a second substrate together with a sealant, said first substrate including a scan signal line, an image signal line, and a plurality of electrodes; and a first orientation controlling membrane;~~

forming a said second substrate including a color filter, and a shading plate, and a second orientation controlling membrane, said sealant being formed at outer edge between the substrates and a part thereof reaching ends of the substrates to form an injection inlet for injecting liquid crystal;

forming a projecting pattern either at a position corresponding to the scan signal line on one face of the first substrate or at a position corresponding to the shading membrane on one face of the second substrate on an under layer of the first orientation controlling membrane, on an under layer of the second orientation controlling membrane, or on both under layers;

forming an orientation controlling membrane on a face of the first or second substrate on which said projecting pattern is formed;

disposing orientation controlling membranes on the first and second substrate so as to face each other;

defining a gap between the first substrate and the second substrates by

disposing a spacer, which is smaller than said gap and having a functional group on the surface thereof, on said projecting pattern, and

bringing said all spacers disposed at parts other than said projecting pattern into contact only with either the first orientation controlling membrane of either the first substrate or the second substrate or the second orientation controlling membrane at a portion other than said projecting pattern using van der Waals bonding or hydrogen bonding;

forming a panel of an in-plane switching type liquid display by joining said first substrate and said second substrate together with a sealant that is formed at an outer edge between the first and second substrates and a part thereof reaching ends of the first and second substrates to form an injection inlet for injecting liquid crystal;

disposing said panel in a liquid crystal injector in which a container filled with liquid crystal is disposed;

bringing back a pressure of said liquid crystal injector to atmospheric pressure while said injection opening being soaked into liquid crystal in said container, after evacuating air from said liquid crystal injector and said panel; and

sealing said injecting opening after filling said panel with liquid crystal through said injection inlet utilizing pressure difference and leaving the pressure in said panel coming to be not less than -0.3 kgf/cm² with respect to the atmospheric pressure.